BAC ONE-ELEVEN

The object of this booklet is to tell you something of the

BAC ONE-ELEVEN

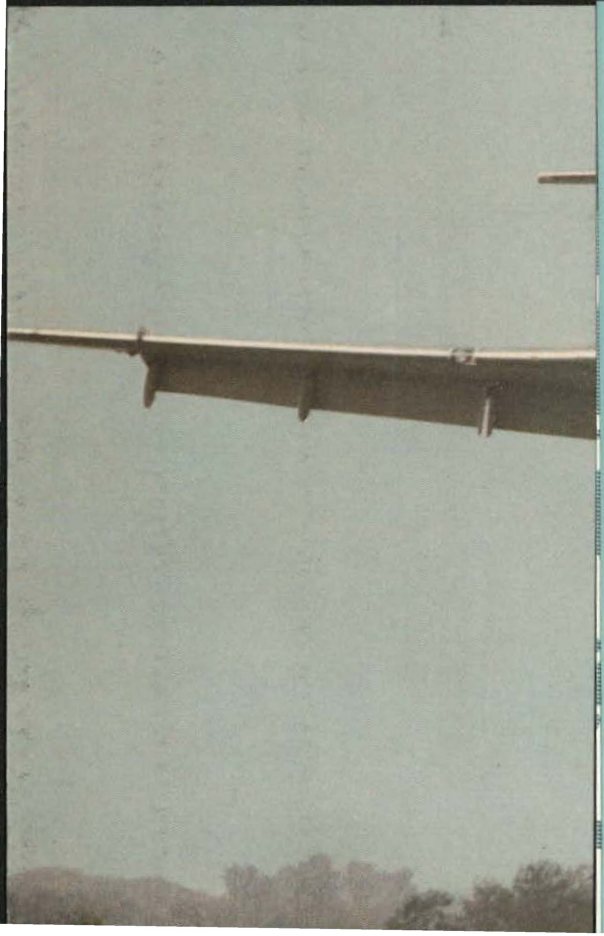
short-haul jet and of the Corporation which designed and built it.

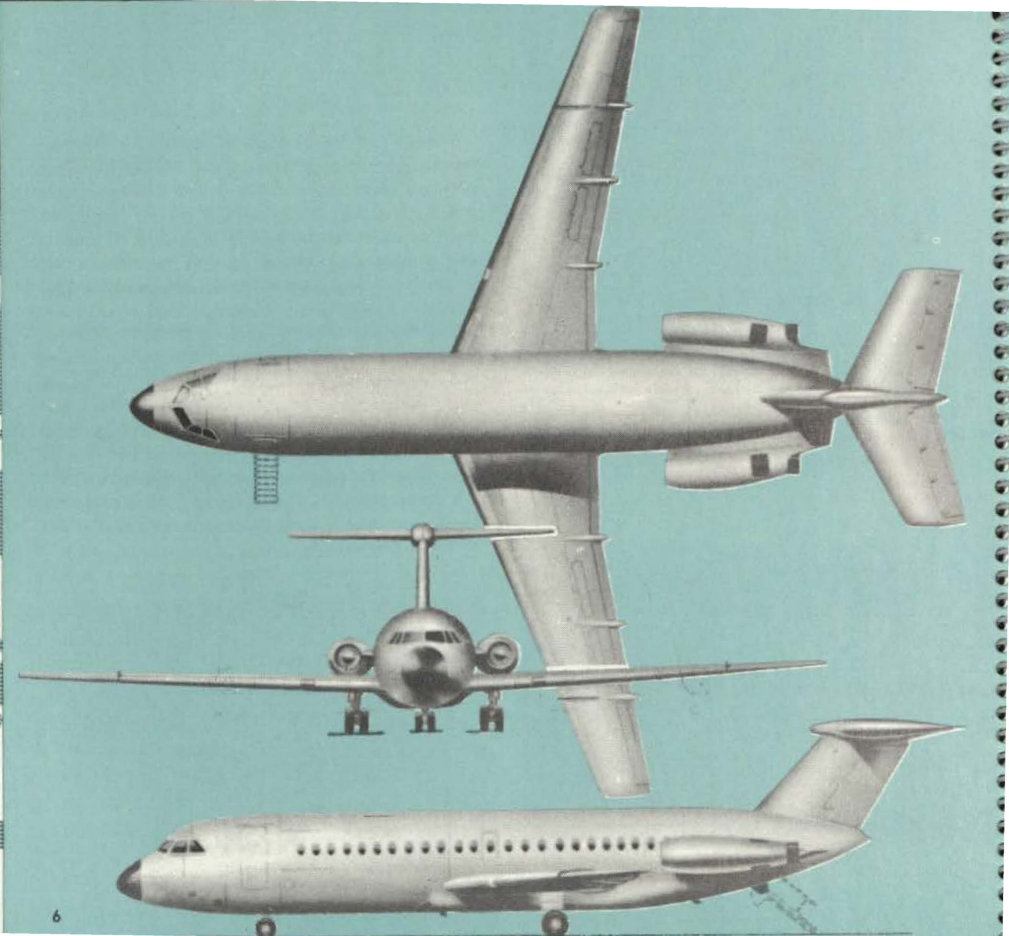
As there is no such thing as a "standard" civil transport, the version of the One-Eleven ordered by a particular airline may differ in detail from the aircraft described here — but there will be no changes in fundamentals.

We believe the BAC One-Eleven to be the finest short-haul aircraft in the world. We say this from an unrivalled experience of designing and building short-haul airliners continuously since 1946 — including the knowledge gained from over 430 Viscounts.

The BAC One-Eleven is a "friendly" aeroplane — but it has the most aristocratic of pedigrees and is powered by engines which match it in experience and integrity.

We are certain that airlines and their passengers are going to be very happy to operate and to ride in the BAC One-Eleven.





THE TAILOR-MADE JET FAMILY

A 'family' of versions of the basic One-Eleven has been evolved from continuous contact between the manufacturer and the airlines.

The Model 200 is the basic aircraft and the developments are the models 300 and 400 which convert the extra power of the Rolls-Royce Spey "Dash 25" engine into the additional payload-range performance required by a number of operators to meet local conditions.

All models are designed to carry up to 79 passengers and cruise at up to 550 m.p.h. The only external difference is an increase of 4 inches in the length of the Spey-25 nacelle.

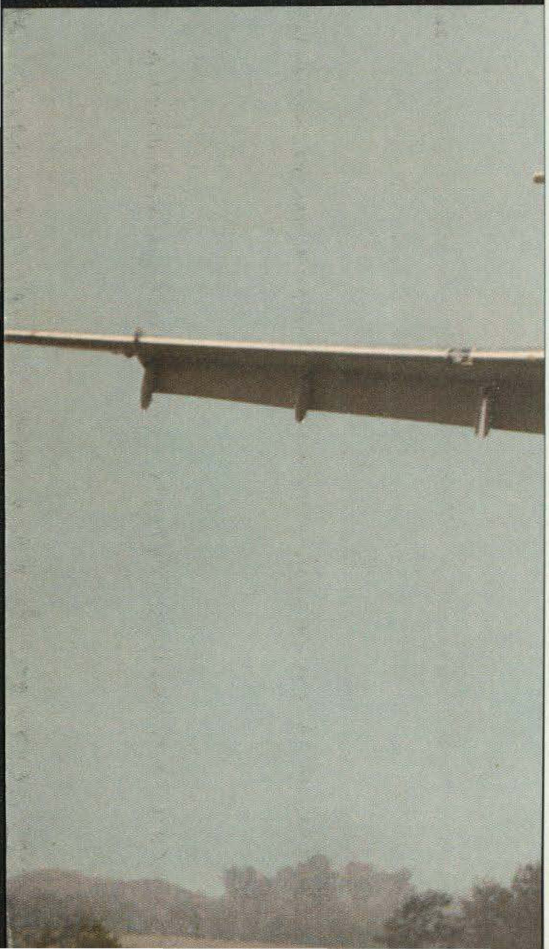
The One-Eleven Model 300, equipped to full airline standard, is of particular interest to airlines requiring a true short-haul jet which also has the ability to fly a medium distance when required. It will, for example, cover a sector of 1,500 miles with a full passenger payload.

The Model 400 is designed to meet the special requirements of a number of United States operators. It has a lower take-off weight which means that the 400 has less range than the 300. This is because in the United States, for which the 400 is designed, there is a large number of bigger jets already covering routes of 1,000 miles and above. The extra power of the Spey-25, however, gives high payloads on dense traffic routes and good airfield performance where restrictive conditions exist in terms of runway length, temperature and altitude.

All models of the BAC One-Eleven contain a considerable number of major systems components of American manufacture and the aircraft has been designed to be fully compatible in operation with American medium and long-haul jets.

The basic One-Eleven, the Model 200, is ideally suited for operation over networks where runway, route distances and traffic densities do not require the extra power.

The various models of the BAC One-Eleven are in fact "tailor-made" for the environments in which they operate.



KEY POINTS FOR PASSENGERS

The BAC One-Eleven is the first genuinely 'tailored-for-the-job' short haul jet. It looks right and it looks friendly. The clean-winged, rear-engined shape of the BAC One-Eleven will, in itself, be a valuable sales asset. At many points which it will serve the One-Eleven will be very prominent among all the other virtually indistinguishable and "old fashioned" types.

Both inside and out the BAC One-Eleven has the appearance and all the attributes of a big jet mainliner. The One-Eleven, brings completely new standards of air travel and the proven benefits of jets to short-haul routes hitherto served by propeller-driven aircraft. It has a passenger appeal unequalled by any other aircraft large or small because it has been tailor-made for its job.

A sophisticated airliner, the One-Eleven isn't just for sophisticated airfields. To meet the needs of far-ranging passengers the One-Eleven has been designed to service small secondary terminals as well as those at major international centres.

For people in a hurry, speed merely in the air is not enough. They want to get

aboard fast and get off fast—and this need is met by the One-Eleven's two entrances and its own steps and auxiliary power.

Though a newcomer, the One-Eleven will quickly become one of civil aviation's most popular aircraft. It will, for the first time, bring the comforts, speeds and benefits of jet travel to the overwhelming preponderance of air travellers—those whose journeys are made over distances of a few hundred miles.

New as it is, the One-Eleven has behind it a generation of short-haul flying. It has been tailored for today's requirements from the decade of in-service knowledge gained by its predecessor—the internationally famous Viscount.

The BAC One-Eleven offers the shorter-distance passenger that roominess which makes him come back for more—the big-jet feel which spells comfort. Added to this is the cabin quiet that comes only when engines are positioned at the back of the 'plane. The One-Eleven has the relaxing atmosphere which a carefully planned air-conditioning system brings—an atmosphere maintained on the ground as well as in the air.

Today's passengers are discerning people and they have discerning tastes. Created as an integral part of the One-Eleven's basic concept is an easy-on-the-eye interior, styled by a top American design consultant (Charles Butler Associates of New York).

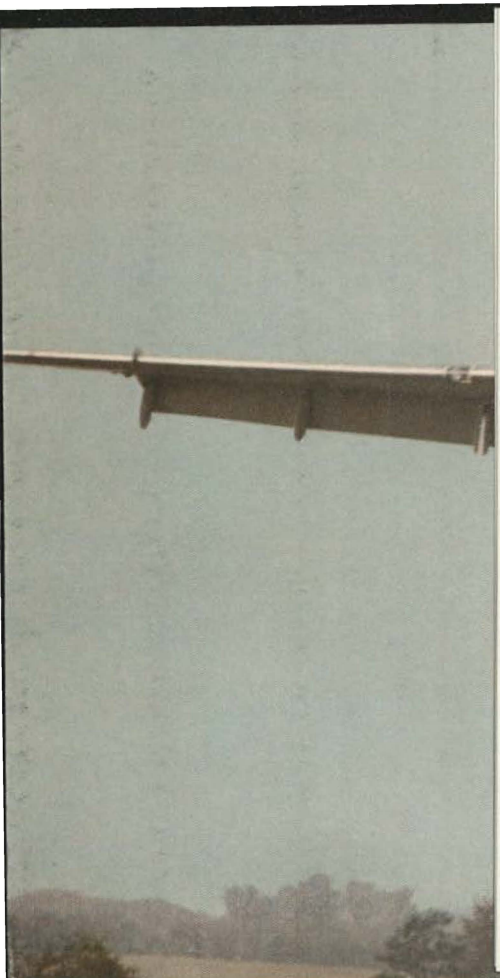
Experienced passengers will appreciate the many finer points of cabin layout, decor and design in which the aircraft abounds. One of the more obvious of these is the provision of 14 in by 9 in elliptical windows every 20 in to give each seat row two windows.

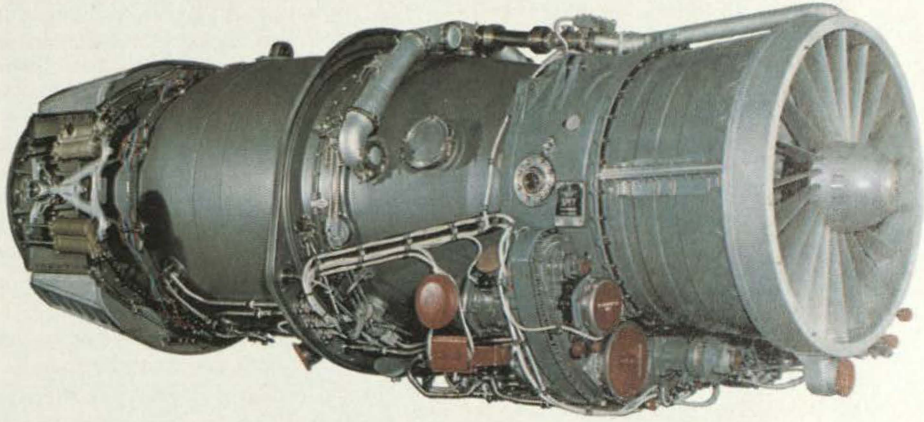
Speed and Comfort

If speed is a No 1 selling factor (as is so often maintained) then the 550 m.p.h. One-Eleven offers block speeds and times comparable with all the big jets. These are not likely to be significantly surpassed on short-haul service unless there is some major new breakthrough in the state of art. In other words, the BAC One-Eleven is not only a winner today but will stay at the head of the field for all the foreseeable future.

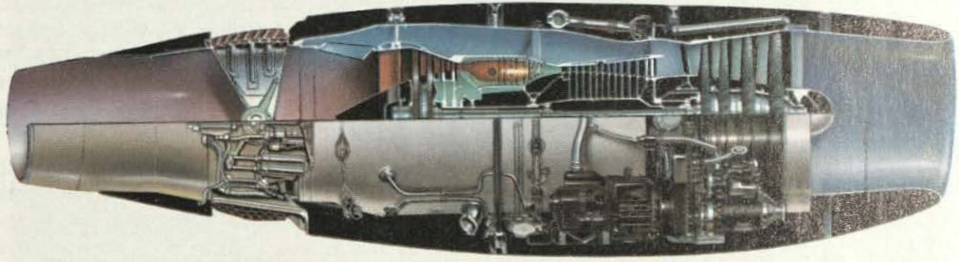
In terms of comfort, the rear-engined layout gives superbly quiet and vibration-free conditions throughout the passenger cabin. It ensures a first-class trip for every class of passenger.

The cabin itself is extremely spacious and a big comfort factor is its elbow





POWERED BY ROLLS-ROYCE



The BAC One-Eleven—like the Viscount before it—can add those magic words after its name "Powered by Rolls-Royce". The engines are two Spey-2 (Mk 506-14) turbofans of 10,400 lb nominal sea level static thrust each. The engine and pod installation is generally similar to the side pod installation of the de Havilland Trident and has therefore come to the One-Eleven with a good background of flight experience. The Spey "dash 25" engine in the One-Eleven 300 and 400 models is some 600 lb of thrust more powerful.

The Spey is an axial-flow, twin-spool high pressure-ratio (16.7:1) turbofan engine of moderate by-pass ratio specifically designed for short to medium range civil transports.

Its advanced design gives exceptionally good specific fuel consumption and low noise levels.

The twin-spool compressor, together with the by-pass principle (Spey by-pass ratio 1:1), gives better fuel economy, more rapid power response and higher thrust-to-weight ratio compared with the single-spool axial design. Good acceleration and deceleration rates enable the One-Eleven to offer short take-off and landing performance.

The 12-stage high-pressure axial compressor is driven by its own 2-stage high-pressure turbine. The 4-stage low-pressure axial compressor is driven by a separate 2-stage low-pressure turbine, the shaft of which runs inside the high-pressure shaft. Inside the annular combustion system casing are 10 straight flow flame tubes. This combustion arrangement is similar to that of the Conway and Avon with cooling features already proved in Dart operation. Flame temperatures are similar to those in Conway engines in current operation and a similar type of air-cooled turbine blade is used. Air-cooled bearings are also used leading to a low oil deterioration rate. Oil is, therefore, not normally changed between overhauls leading to very low oil costs.

Specific fuel consumption is 0.783 lb/hr/lb at 25,000ft (7,620m), M=0.78. Variation with altitude is small, giving good operational flexibility.

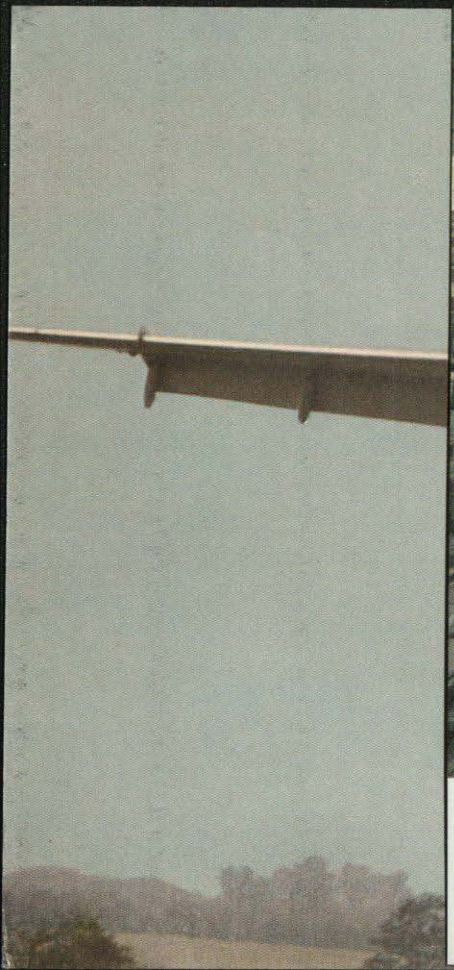
Engine response to slam acceleration is good, maximum power being obtained within 2 seconds from the approach conditions at 110 knots and within 5 seconds from idling conditions.

Engine and aircraft accessories are grouped on the underside of the engine for ready accessibility and simple cooling.

Engine starting is by a low-pressure air starter supplied by the A.P.U. or an external power supply. Each engine can also be started by cross feed from the other engine.

The Spey is fitted with a thrust reverser similar to that fitted to the Conway and Avon in operation in the Boeing 707 and Comet.

The Spey is based on the Rolls-Royce Conway which is the world's most reliable jet engine. It has lower temperatures and should bid fair to beat even the Conway's record. On average, a Conway would have to fly 10½ hours per day, 365 days a year, for ten years before it had to be shut down in flight through a fault!



Wing panels for BAC One-Eleven and VC10 are milled from solid aluminium alloy in this Weybridge structural machine shop. In the foreground completed panels are being inspected.

TECHNICAL INTEGRITY

Four of British Aircraft Corporation's factories are engaged in One-Eleven production. Together, they represent a manufacturing experience and integrity which are unsurpassed in the world.

This wealth of 'know-how 'is firmly based on the world success of the best-selling Viscount turbo-prop, and the One-Eleven design started with a background of four million Viscount hours already built into it.

But the One-Eleven has the unrivalled advantage of being developed in the wake not only of Viscount and the Britannia, but of the later Vanguard and VC10. From both these aircraft have come many new techniques of engineering for reliability. The VC10s have provided practical knowledge of rear-engine aerodynamics and engineering.

From both the Vanguard and VC10 the One-Eleven inherits milled-from-the-solid wing planks and other key structural features for long-fatigue-resisting life.

All these advances have led to engineering features especially tailored for the short-haul operator's requirements. The One-Eleven is a built-for-the-job product designed to withstand frequent take-offs and landings and rugged operating conditions.

The One-Eleven operator purchases the reliability that comes from using proven components and from linking fail-safe systems (not mere ancillaries) to the auxiliary power unit to ensure ground independence.

Simple systems lead to simple flight decks—such as that in the One-Eleven. This spells fatigue-free duty hours for the two-man crew, written out in terms of panoramic windshields, fingertip controls and 'at-a-glance' instrument panels.

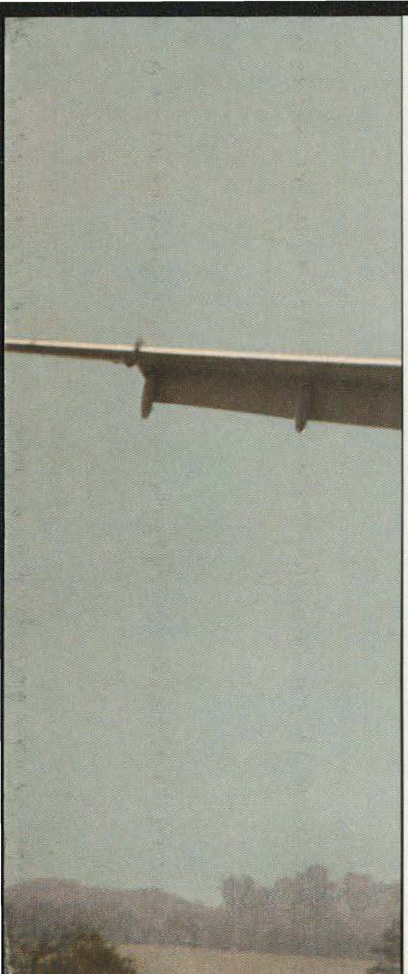
Designed, too, with airline engineers in mind, the head-and-shoulder-level One-Eleven frees the engineer, working under pressure, from time-wasting hard-of-access hatches. The engines—away from the wings—are easily accessible, as are all the One-Eleven systems.

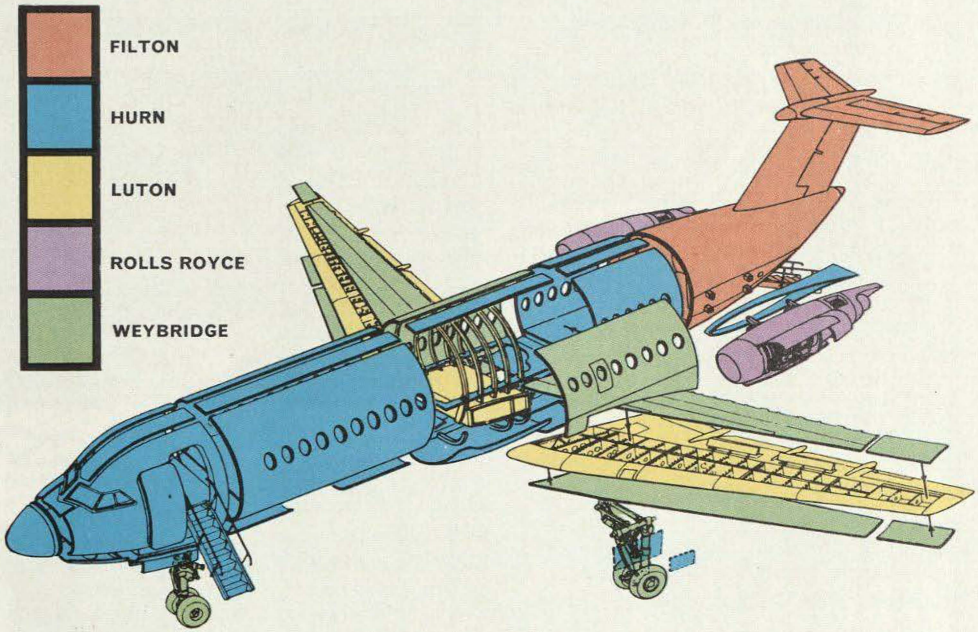
The engines themselves are Rolls-Royce Spey turbofans which give the One-Eleven its 550 m.p.h. cruising speed. "Powered by Rolls-Royce" is a hallmark which needs no embellishment.

From the drawing-board to the production line, laboratory tests shadowed the design evolution into hardware — backing the flight test programme with a store of facts and figures covering, with X-ray thoroughness, the whole anatomy of the One-Eleven.

Great attention has been paid to the effects of the arduous duty cycle of intensive short haul operation with very frequent take-offs, landings and cabin pressurisations.

All materials have been carefully chosen to





TESTING AND PRODUCTION

The BAC One-Eleven final assembly line is at British Aircraft Corporation's Hurn Works, situated on a large civil airport near Bournemouth, on the South Coast of England.

Hurn is well used to large-scale production as it built two-thirds of all the Viscounts. Hurn has built more propeller-turbine engined airliners than any other factory in the Western world. One-Eleven fuselages are assembled at Hurn, but other major components are fed to the production line from BAC factories elsewhere in England.

WEYBRIDGE produces major machined components—e.g. sculptured wing skin and fuselage panels and the landing gear. Fuselage basic structural frames are rolled at Weybridge.

LUTON produces the wings, including centre section in the lower fuselage, incorporating machined panels from Weybridge.

FILTON produces the rear fuselage and tail unit.

ROLLS-ROYCE supplies the complete Spey power-plant, including the nacelles.

The One-Eleven has been produced to a highly competitive time scale of 27 months to first flight and 3¾ years from start of design to delivery of the first certificated aeroplane. The system of spreading the design and production task over the full resources of British Aircraft Corporation has been an essential and extremely successful feature of this programme.

Milled from the Solid

The two most notable aspects of One-Eleven production are:—

1. The extensive use of components "sculptured" from solid light alloy billets—as opposed to built-up members incorporating a large number of parts riveted or bolted together.

2. The use of high-quality, extremely precise jigs and tools to produce accurate and easily interchanged components.

To support the design and production programmes, complete full-scale engineering mock-ups were built at Luton (wing) and Hurn (remainder of aircraft). A comprehensive laboratory test programme has covered the entire aircraft in all aspects — from tests of structural details, materials and components to tests of the complete airframe and full-scale replicas of systems built up from the production components. The BAC One-Eleven is believed to be the most comprehensively tested civil aircraft of any kind yet produced.

MOST TESTED JET

The world-wide operating experience of BAC enables it to lay down realistic test programmes on any new aircraft.

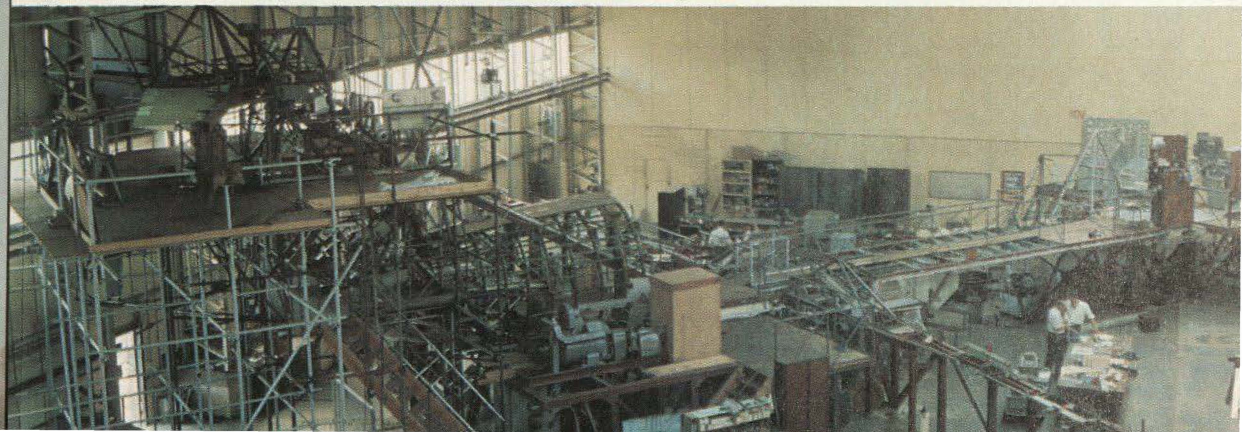
The structures and systems test schedule for the BAC One-Eleven is, without doubt, the fullest and most comprehensive ever done on a short haul aircraft—propeller or jet. It is fully realised by BAC that one of the greatest contributions an aircraft manufacturer can make to the support of his product is to ensure that, throughout a long life, the structure is reliable and requires the minimum of inspection and repair.

With the One-Eleven the average flight time will probably be no more than 45 minutes, which means that the structure had to be designed for a minimum crack-free life of at least 30,000 hours, or 40,000 flight cycles. The comprehensive test programme goes well beyond this figure and much of the structure will in fact be tested to 100,000 flights—or 75,000 flying hours—which is the equivalent of 25 years of intensive operation.

The One-Eleven programme is based on fatigue tests and water tank tests made on the Viscount, Britannia, Vanguard and VC10. The structural materials, manufacturing techniques and processes used for the One-Eleven are similar to those for the Vanguard and VC10 on which great experience has already been gained. Again, the loading data obtained from strain range recorders fitted to many airline-operated Viscounts has given the British Aircraft Corporation an unparalleled source of data on atmospheric conditions and gust frequencies in world wide operation. This information has been fed into all relevant aspects of the One-Eleven's design.

A complete One-Eleven airframe is being used for static loading tests, and in order to accelerate the programme, this airframe is being tested in two parts. One comprises a forward and centre fuselage, together with wings and control surfaces. The other is a rear fuselage with tail assembly, also complete with control surfaces.

Full-scale hydraulic and flying control systems test rig



In addition to the static test specimen, a complete fuselage with wings and fin is being used for the programme of fatigue tests, during which flight load cycles will be simulated while the fuselage is pressurized in a water tank. The first phase, equivalent to 30,000 flights, is being carried out with the fuselage and fin only. Loads are applied to the wing centre section to represent wing input loads. When these tests are complete, the wings will be attached and the programme continued until the equivalent of 100,000 flights has been achieved. Finally, fail-safe tests will be made in which fatigue cracks will be induced artificially and rates of crack propagation measured.

The exhaustive test programme pursued on the landing gear comprises a main and nose leg assembly for strength and wear tests and another main and nose leg assembly for fatigue tests.

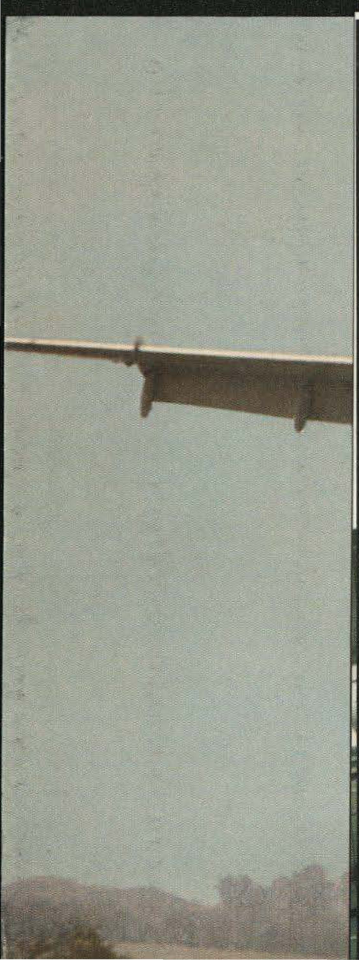
The test leg assemblies are complete with wheels and tyres and are being subjected to drop tests to check shock absorption characteristics and to simulate every condition which might be encountered in service.

Fatigue tests on the landing gear are planned to involve the application of loads to represent 240,000 flights including retraction, extension, landing and taxying loads. The programme is aimed at an overhaul life of at least 3,000 hours.

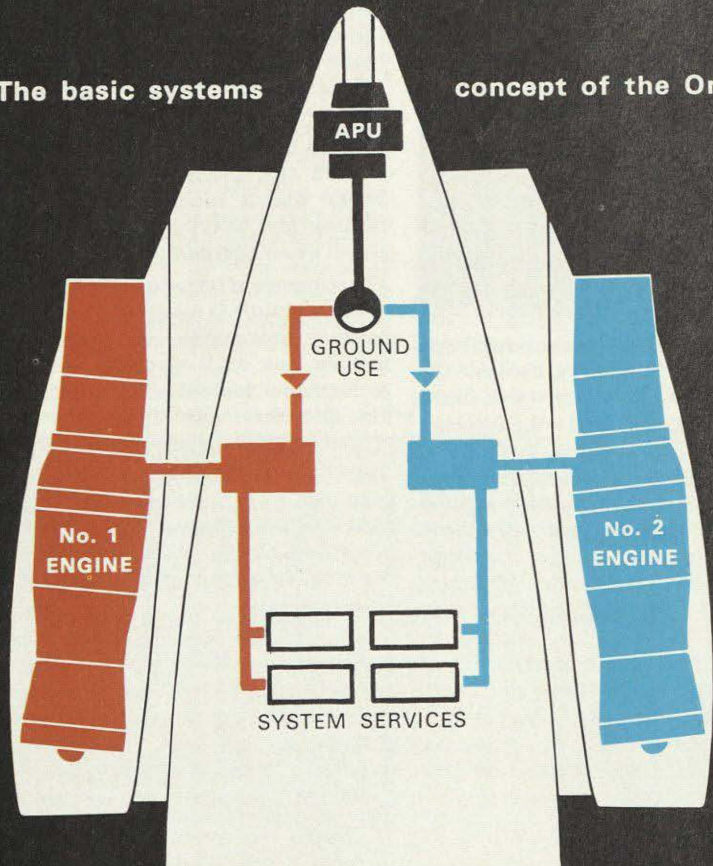
The sequence of tests to prove structural integrity of the airframe is matched by an equally comprehensive programme of systems tests. These include not only rigorous environmental and performance evaluation of individual components but also the construction and operation of a complete, full size test rig for each major system.

For the equipment these tests have been programmed to achieve minimum overhaul lives of 3,000 operating hours. Even after the basic test programme is completed these rigs can assist in "trouble shooting" should unexpected problems arise in service.

The unrivalled experience of British Aircraft Corporation, particularly in the production and operation of short haul turbine transports, together with its extensive and meticulous test programmes, will ensure that the integrity and reliability of the One-Eleven will meet the high standards demanded by short haul operators.



The basic systems concept of the One-Eleven

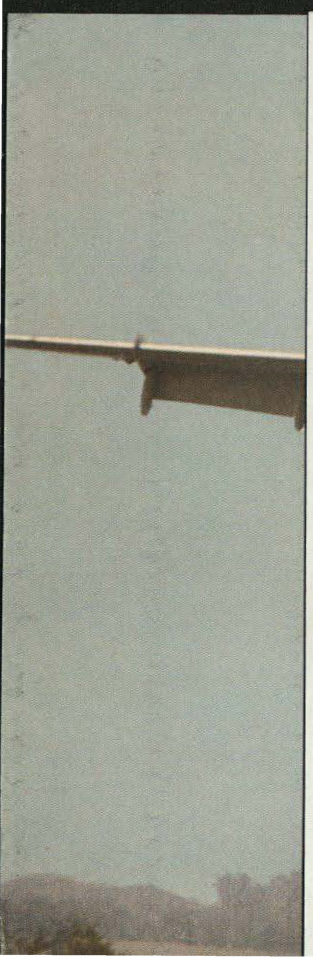


SYSTEMS PHILOSOPHY

The basic system philosophy used in the design of the aircraft is to split each system into independent halves, each with its own power source. All services are capable of operation from one half-system only but in normal operation both halves are in use simultaneously. Thus, No. 1 system is the emergency for No. 2 and No. 2 system the emergency for No. 1. As both are normally always working, there is no likelihood of the emergency system being found unserviceable when required for use. There are no redundant 'emergency only' components.

The aircraft uses proven system components wherever possible to give good reliability. In addition complete system test rigs have been used to prove all systems before first flight and subsequently to provide maintenance and life information.

The basic philosophy and the detail engineering are both compatible with the integrity required for full automatic landing. The aircraft is, therefore, able to take full advantage of developments in this field. The basic autopilot specified for the aircraft is the same as that being used in the autoflare installation in the VC10.



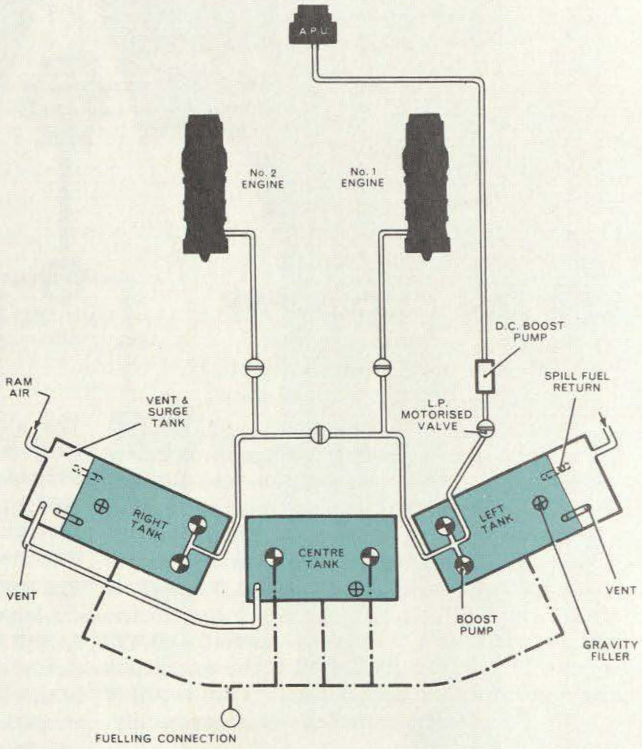
Fuel System

The integral fuel tanks are formed by sealing the main wing torsion box during manufacture. Two tanks are provided, one in each wing giving a total capacity of 2,200 Imperial gallons (2,640 U.S.G.). The wing centre section torsion box, which may be used as an additional fuel tank, holds 850 Imperial gallons (1,020 U.S.G.).

Due to the moderate amount of sweepback employed on the wing, special fuel management procedures are not required. All the fuel in the system is available to either engine.

The vent system incorporates a small surge tank near each wing tip to collect fuel entering the vent system. Fuel from this surge tank is automatically returned to the main tanks thus reducing spillage.

Great care is taken in design and manufacture of the system to avoid trouble from microbiological attack. This is achieved by filling all small undrainable water collecting pockets with a solid, low density epoxy-resin filler and by ensuring that a high standard of protection is applied to all tank internal surfaces.



Hydraulics

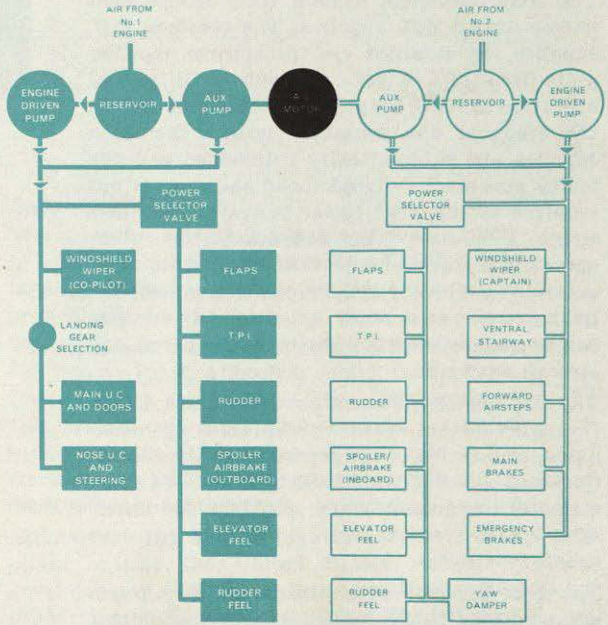
Hydraulic power is used to operate the landing gear, flaps, spoiler/air brakes, tailplane trim, rudder, elevators, nosewheel steering, brakes, elevator and rudder artificial feel units, yaw damper, ventral stairway and windscreen wipers. The optional forward stairway is also hydraulically powered.

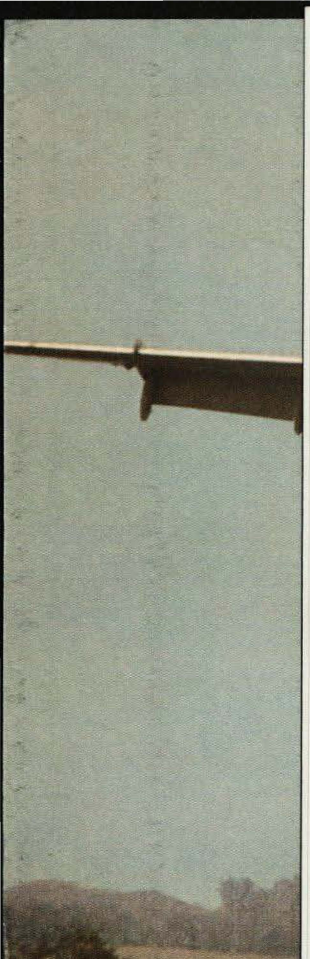
There are two distinctly separate hydraulic systems, normally both operating, each with its own reservoir, engine-driven pump and supply lines. Should either of the engine-driven pumps fail, an auxiliary electric (A.C.) driven pump is available to maintain that system without any loss of services.

Items which affect control of the aircraft—rudder, elevators, tailplane trim, flaps, spoilers and artificial feel—are operated by both systems, i.e. duplicated. Other items which affect aircraft safety are provided with adequate safeguards.

The system uses Skydrol 500A fire-resistant hydraulic fluid. The aircraft is fully protected against the corrosive effects of this fluid.

The maximum working pressure of the system is 3,000 p.s.i. Pressure lines are of stainless steel and flareless connections are used throughout.



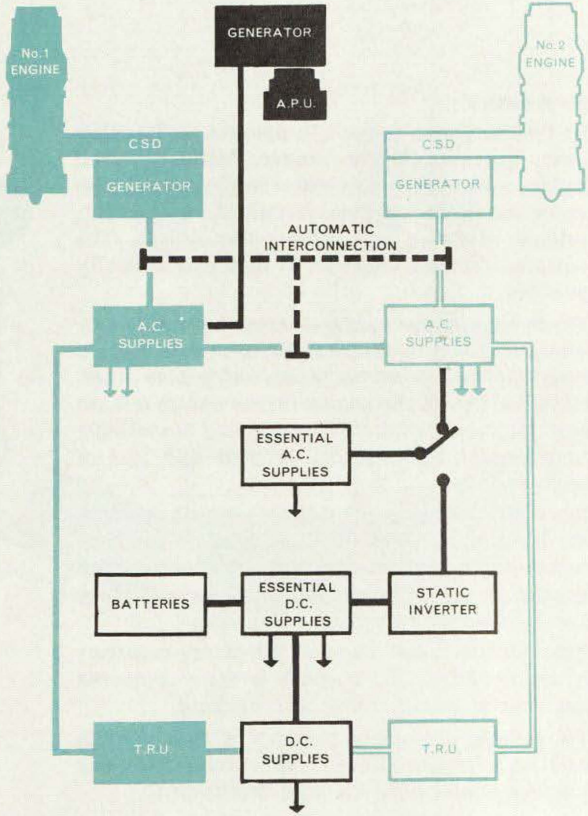


Electrical System

The basic electrical system is in independent halves for all A.C. supplies. The common D.C. supplies are obtained via transformer rectifier units from the two main A.C. sources. In normal operation the A.C. supplies are not commoned. In the event of one generator failing the main supplies are automatically commoned and the faulty generator isolated. Load shedding is not required as sufficient power is available from a single generator. The generators are never operated in parallel and thus the necessity of providing generator synchronisation is avoided. In an extreme emergency, essential A.C. services can be maintained via a static inverter from the aircraft batteries.

The two engine-mounted generators are driven through constant-speed drives, featuring mechanical connection of the generator to the engine. Constant speeding is achieved by a variable speed airmotor/compressor which provides the difference between engine drive speed and required generator speed.

The three generators (the third is on the A.P.U.), are licence-built Westinghouse 30 KVA machines, which already have a great deal of service. A.C. power is at 200 volts, 400 cps, 3 phase.



Air Conditioning and De-icing

There are two independent pressurisation and air conditioning systems, one supplying the flight deck and the other the passenger cabin. Each uses H.P. compressor air tapped from the engines. This air is passed through a heat exchanger for cooling, the cooling air for the heat exchanger being obtained from an L.P. compressor tapping. Engine warm air is also used for de-icing the leading edges of the wings and tail unit and the powerplant intakes. Flight deck windows are electrically de-iced.

Each air conditioning unit consists of a 'boot strap' cold air unit, using the compressor-turbine principle, and heat exchangers. The cooling air flow to the heat exchangers is provided by ram air, with an electric fan for ground use. The cold air outlets, in the cabin and flight deck, are provided with a cool air supply at all times. Water separators are fitted to both systems.

Temperature control on each system is achieved by controlled mixing of the hot and cold airstreams. The two system temperature controls are independent, enabling different values for flight deck and cabin to be obtained.

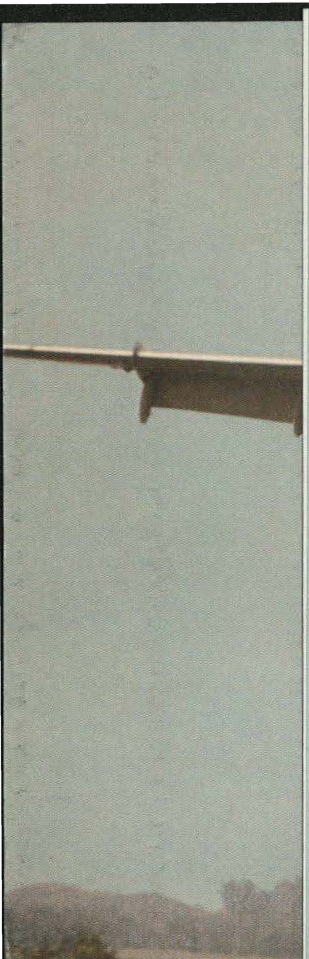
Conditioned air is fed into the cabin via wall heating ducts along the whole length of the cabin just underneath the overhead racks. Pressure control is automatic by an electro-pneumatic control system.

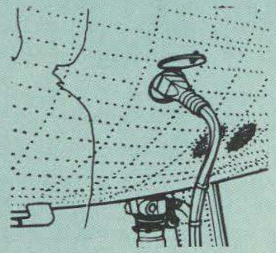
Automatic Landing

The autopilot system is capable of development to autoflare and subsequently to automatic landing, subject to the development of suitable ground aids.

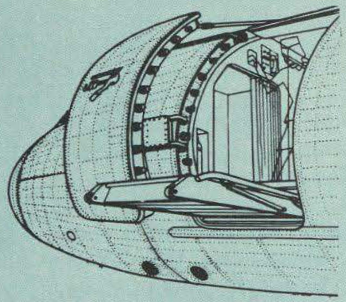
The system is being developed by Elliotts using the Bendix PB.20 Autopilot, which is the basic type fitted to the aircraft. The constituents of this system are also being used in a similar manner on the VC10 airliner. The results of the work on the VC10 have been read across in the development of the aircraft.

Elliotts are the largest manufacturer of autopilots outside the United States, and their developments have been based on the licence production of Bendix Autopilots. Their design and service support are closely co-ordinated with Bendix.

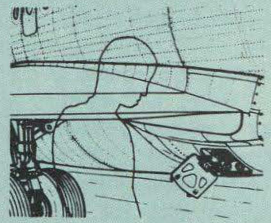




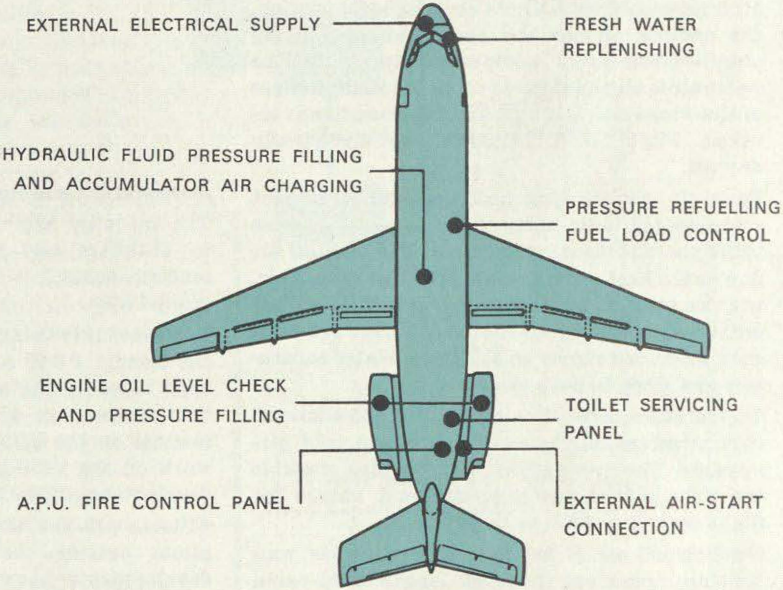
External electrical point

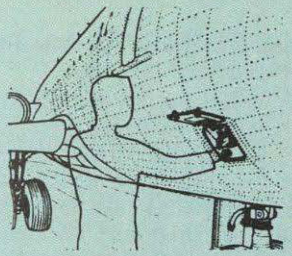


Optional forward airsteps

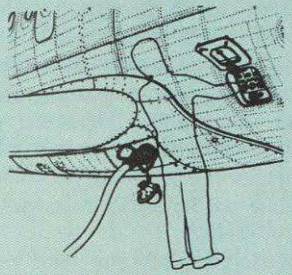


Hydraulic and pneumatic charging points

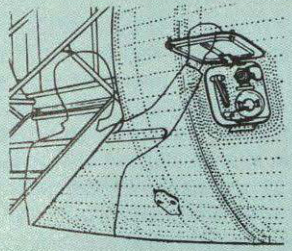




Fresh water point



Refuelling point



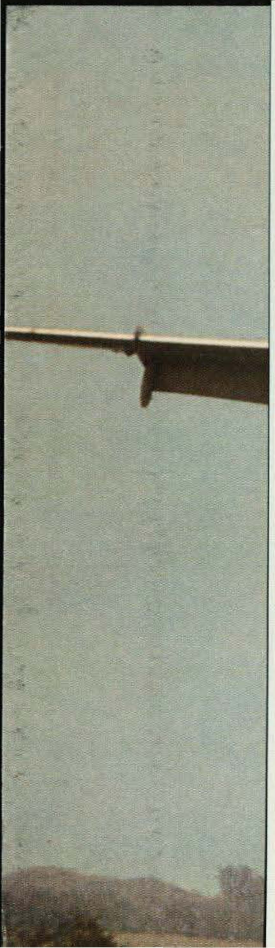
Toilet servicing panel

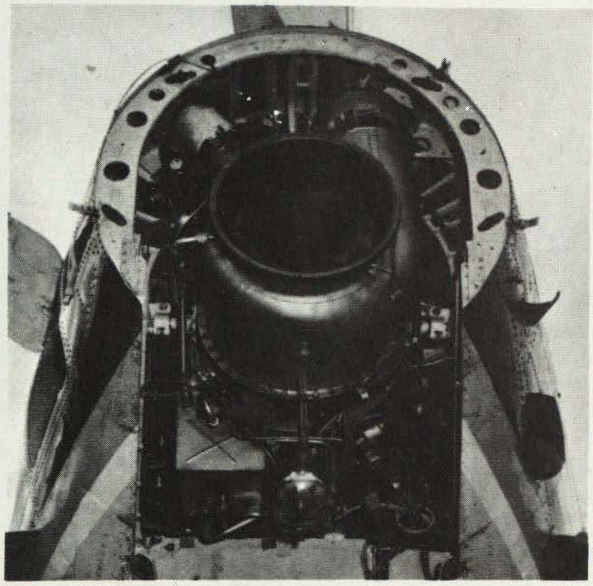
QUICK TURN ROUND

To prevent delays caused by shortage of ground equipment and to reduce turn round time and accidental damage from ground equipment, the One-Eleven has been made "self-contained". An Auxiliary Power Unit provides air for conditioning the cabin and engine starting and power for the aircraft's systems. Airsteps, waist-high freight bays and servicing points all located for simultaneous attention, complete the picture.

At a "whistle stop" no servicing is required. With few passengers getting on and off, two men and a baggage truck should suffice to turn a One-Eleven round in under ten minutes.

At a terminal stop where passengers and freight are removed, cabin cleaning dictates the turn round time. Fuelling takes a maximum of ten minutes and other tasks—galley replenishment, toilet and domestic water recharging, hydraulic and engine oil and oxygen level checks—less.





The Auxiliary Power Unit

The provision of an auxiliary power unit—the One-Eleven's "third engine"—plays a big part in the achievement of the design aim.

This A.P.U., built by AiResearch, is a small on-board gas turbine mounted in the fuselage tailcone. It is started by press-button from the cockpit and runs from the main fuel supply. When in use the A.P.U. provides power to operate the air conditioning system, the heating and the electrics, and it can also start the main engines through constant-speed-drive starters.

The One-Eleven can thus be largely (or, indeed, completely) independent of ground equipment and personnel. There is no need to run the main engines on the ramp simply to provide power for systems or accessories, thus directly reducing costs. The A.P.U. can do all that is necessary. It provides both shaft and pneumatic power. Shaft power up to 200 h.p. from the turbine will drive an alternator to provide 30 kva AC electricity while the main engines are shut off. Compressed air—110 lb per minute at a pressure ratio of about 3:1—is used to power air conditioning and heating systems.

Fully automatic, the A.P.U. is equipped with a control system which sequences starting, fuel control and ignition to provide a stable starting cycle requiring only a single switch.

The whole A.P.U. assembly can be easily removed or reassembled in about 15 minutes.

The fitment of this Auxiliary Power Unit not only makes the aircraft self-sufficient on the ground but gives considerable associated benefits.

Ground equipment such as power units, air conditioning units, and engine starting devices, together with the towing tractor and the labour to operate them, are eliminated. The capital investment, maintenance costs and labour charges of these facilities are saved. The total saving is large when it is considered that almost all stations, and probably a number of diversionary airfields, would have to be so equipped, some of them with considerable duplication.

There are operational benefits, however, to those operators who already have an investment in ground equipment. The self-contained transport eases scheduling problems associated with the availability of particular apron positions or gates. In addition the reduction in numbers of vehicles, steps, etc., moving near the aircraft will mean fewer accidents and reduced cost of repairs.

Intermediate stops call only for baggage handling and sometimes fuelling. Thus, ground time can be cut to a minimum which, in many cases, means an extra revenue sector during the working day.

Ground Servicing

When ground servicing is scheduled, it will be found that the BAC One-Eleven can be handled very smoothly. The single refuelling point ahead of the right wing root accepts 300 Imperial gallons a minute from a standard 2½ inch connection. The full fuel load can be put in within ten minutes. Both refuelling and defuelling are controlled at a panel nearby without the need to enter the aircraft.

All other service points (water, toilet etc.) are external, and catering supplies are loaded through a door on the righthand side clear of the passenger exits.

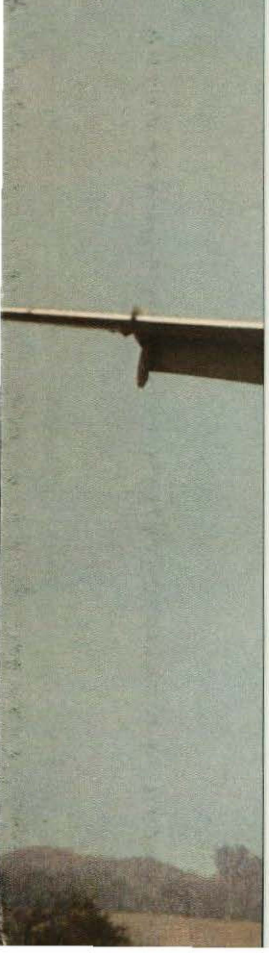
The passengers use an integral stairway at the ventral entrance and the forward entrance door can embody a simple integral stairway which retracts under the cabin floor without folding and without causing any doorway obstruction.

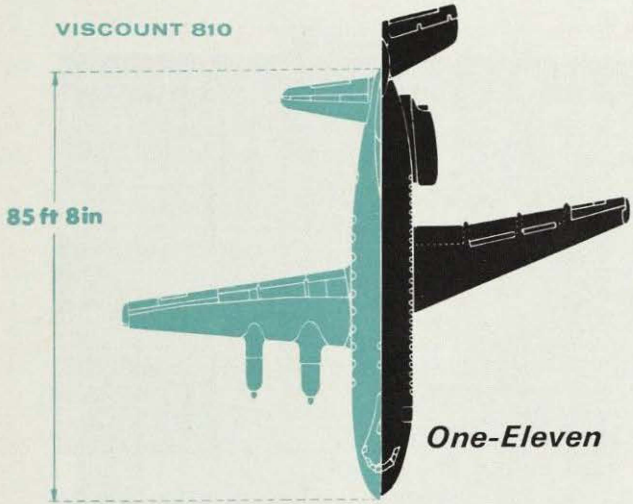
Freight and baggage may be loaded directly from ground level without special equipment.

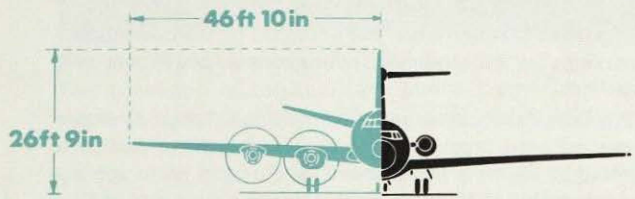
TURN ROUND ACTION	ACTION REQUIRED	REMARKS
SHUT DOWN ENGINES	✓	
POSITION PASSENGER STEPS		AIRSTEPS
UNLOAD PASSENGERS AND BAGGAGE	✓	
POSITION AND CONNECT GROUND POWER UNIT		APU
POSITION AND CONNECT AIR CONDITIONING UNIT		APU
SERVICE GALLEY	✓	SERVICE DOOR
CLEAN CABIN	✓	
REFUEL	✓	SINGLE POINT
LOAD PASSENGERS AND BAGGAGE	✓	
REMOVE PASSENGER STEPS		AIRSTEPS
DISCONNECT AND REMOVE AIR CONDITIONING UNIT		APU
START ENGINES	✓	APU
DISCONNECT AND REMOVE GROUND POWER UNIT		APU

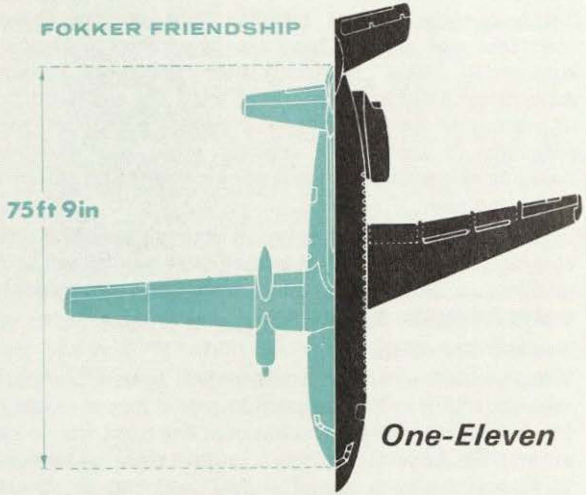
The One-Eleven is easily handled on the ground. At normal gross weight, and from a flat concrete surface, it can be towed by any standard type of tractor capable of a drawbar pull of about 5,000 lb. The aircraft is towed or pushed through a tow bar attached to the nose undercarriage leg which should incorporate a 7,500 lb overload device.

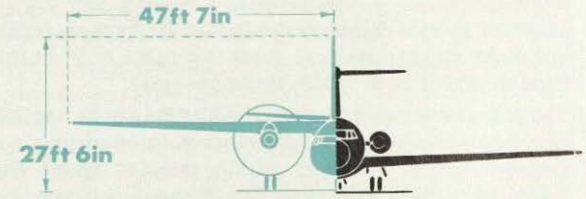
The nosewheel can be rotated through 110 degrees either way without disconnecting the torsion links and it is possible to turn the aircraft about one main undercarriage leg. Under power control the nose leg can be turned through 78 degrees in either direction; this enables the wing tip to be turned within a radius of 51 feet and the landing gear within a radius of 32½ feet.

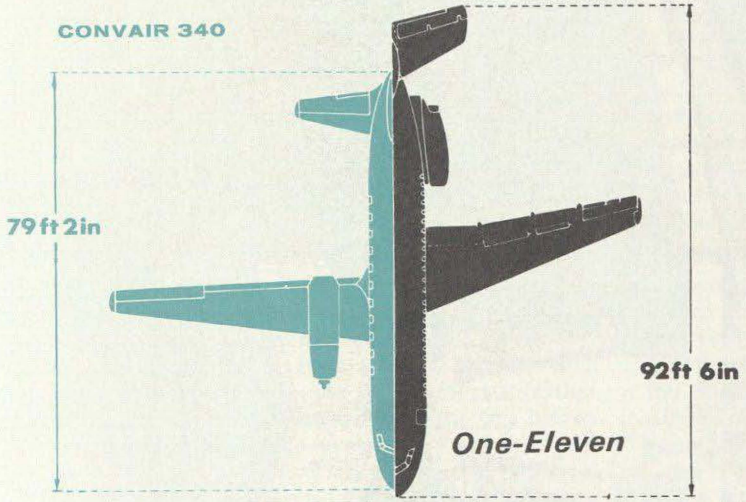



VISCOUNT 810
85 ft 8in
One-Eleven

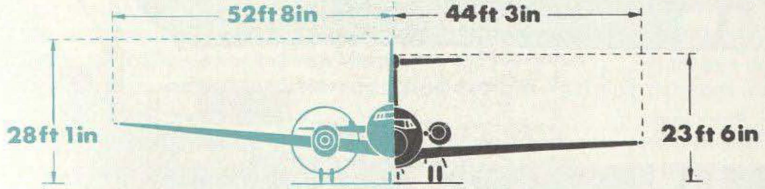

46 ft 10in
26ft 9in

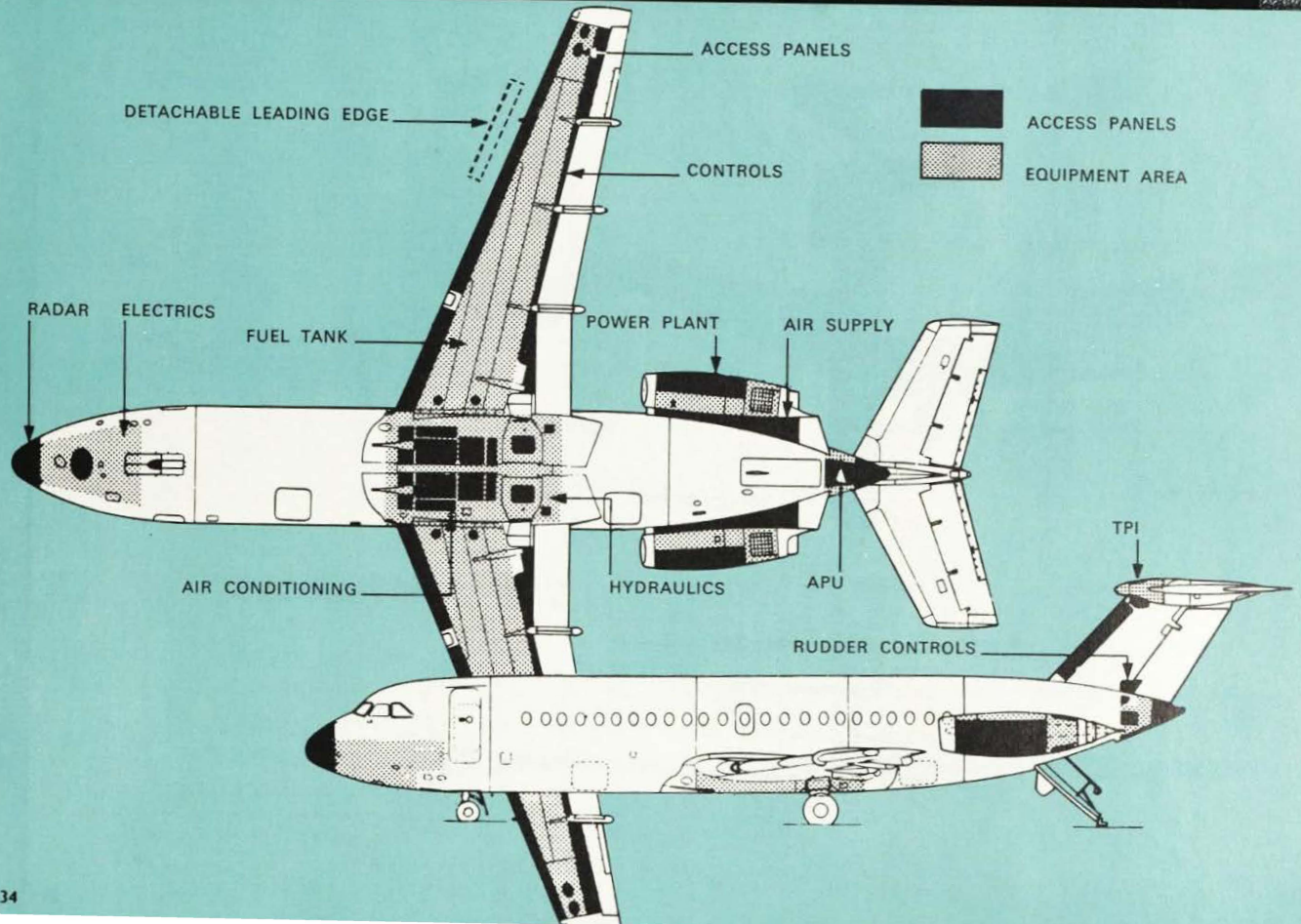

FOKKER FRIENDSHIP
75ft 9in
One-Eleven


47ft 7in
27ft 6in



SIZE COMPARISONS




ACCESS PANELS
DETACHABLE LEADING EDGE
CONTROLS
ACCESS PANELS
EQUIPMENT AREA
RADAR
ELECTRICS
FUEL TANK
POWER PLANT
AIR SUPPLY
TPI
AIR CONDITIONING
HYDRAULICS
APU
RUDDER CONTROLS

DESIGN FOR MAINTENANCE

The BAC One-Eleven has been designed for ease of maintenance and reliability. Technical delay rate for the Vickers Viscount is down to 1.4 per 100 revenue departures. BAC aims to lower this figure still further with the One-Eleven. To achieve this the One-Eleven was designed around components with the widest airborne experience; extensive laboratory and flight test programme have been carried out and component suppliers have entered into stringent warranty agreements covering overhaul lives and after sales service.

For the BAC One-Eleven, customer airlines have formed three committees which, in conjunction with BAC and Rolls-Royce, have worked on a Maintenance Programme aimed at providing the airlines with the greatest flexibility.

This is a breakaway from the old concept of "Preventive Maintenance" which for safety reasons must be applied to an aircraft without fail-safe systems and structure. It enables maintenance to be considered as part of the overall operation of the One-Eleven as the maximum "down time" need not be longer than eight hours.

Component Concept

In line with the current approach to the establishment of overhaul lives for system components on a basis of "test and repair as necessary" or "On Condition" for such units as do not suffer from a definite Wear Out condition, some 65 per cent of the components on the One-Eleven have been submitted to the Airworthiness Authorities for lifeing "On Condition". This is made possible by the use of the split system philosophy and fail-safe approach to structural integrity.

Structural Concept

A minimum crack-free life of 40,000 flights was the One-Eleven structural design aim. Maintenance proposals are based, not only upon this aim, but on the evidence of the extensive and intensive test programme which BAC is carrying out to demonstrate its reality to the Airworthiness Authorities.

Design of the structure is such that should any failure occur it will be visually apparent on what is literally a "walk round" inspection and further, should a failure occur immediately after such an inspection, its rate of increase will be so slow that it will not have reached dangerous proportions by the time the next inspection occurs.

BAC has laid down a sampling programme by which 40 per cent of an operator's fleet should be completely examined during the first 20,000 flights and the remaining 60 per cent before 40,000 flights. To support this operators are asked to carry out visual checks at periods of up to 600 flights, a task which will take about 12 man-hours. Such inspection can be carried out with advantage while a routine inspection is being made, say at 500 hours.

Maintenance Planning

The basic Maintenance Programme may be adapted to suit whatever pattern the operator wishes to adopt.

The aim has been to design the aircraft in such a way that any operation may be carried out in an elapsed time not exceeding eight hours.

Design Requirements

The ability to change a system component without disturbing any other was a design aim, as were ready accessibility and simplicity of mounting. To achieve this, system components have been grouped into specific areas, large access panels have been provided and liberal use made of quick release fasteners, trapped nuts, etc.

To assist maintenance personnel in locating defects in systems the following facilities are built into the One-Eleven:—

Test points on auto pilot units for in situ use of fault analyser.

Test socket for electrical generation protection system check out.

Landing gear micro switch system test socket.

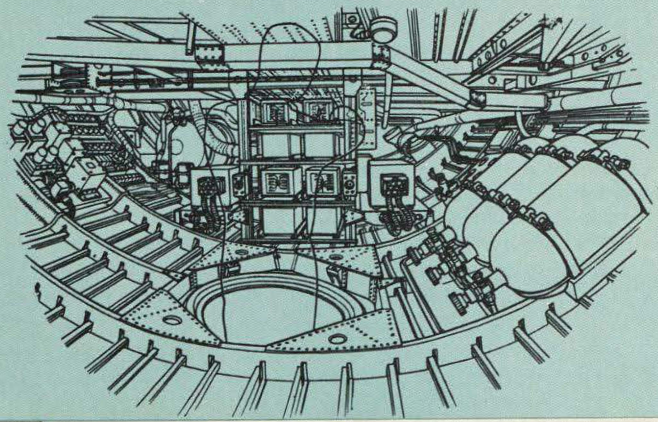
Auxiliary power unit analyser test socket.

Hydraulic system filter clogging indicators.

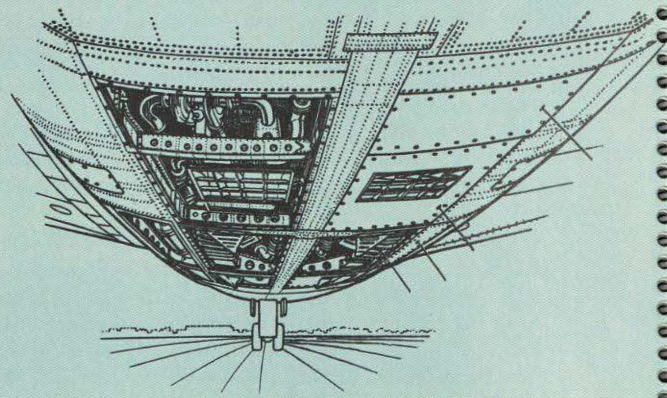
Air conditioning system duct pressure and temperature test points.

Flaps system primary torque shaft failure indicators.

Electrics, oxygen and gyros in bay forward of nosewheel



Air conditioning components

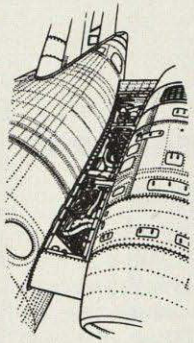


The accessibility of the fuselage structure from inside the cabin by removing the panels has already been dealt with. On the outside, the One-Eleven wings and fuselage underside are close to the ground, and most routine work can be done without using steps or special platforms since items are within easy reach.

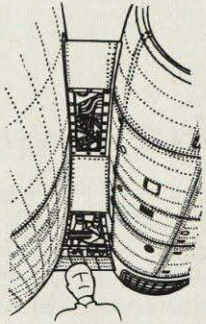
The functional grouping of components in convenient localities has been achieved to an unusually high degree. The nose radar and electrics can be serviced at the nose bay, the air conditioning and hydraulics are fully accessible at ordinary upright working position in the central bay, and the engine accessories are grouped to hand under the engine.

The BAC One-Eleven is, in the view of many airline experts, the most easily serviced, accessible and well planned aircraft ever to come into operation.

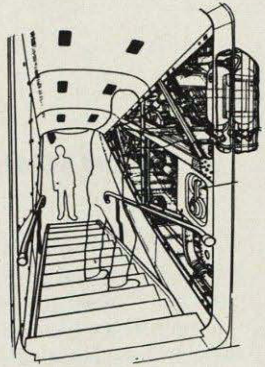
Engine stub (top)



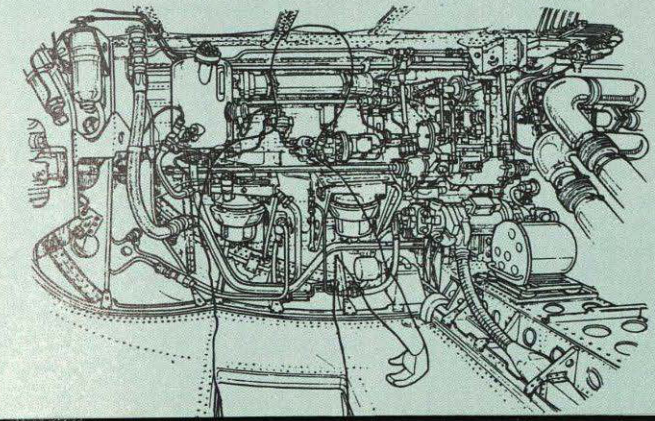
Engine stub (bottom)

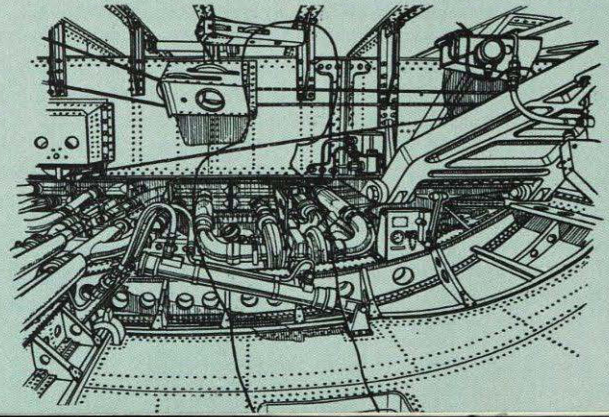


Ventral tunnel



Main wheel bay looking aft (left) and forward (right), giving access to hydraulic and air conditioning equipment





COMMERCIAL CONSIDERATIONS

The BAC One-Eleven is the first jetliner specifically designed for short-haul routes. As a result it offers short-haul operators big-jet facilities at small-jet costs. It is a first-class aeroplane tailored to second-class airfields, easily fitting into the route patterns and schedules of airlines used to planning Viscount and Convair operations.

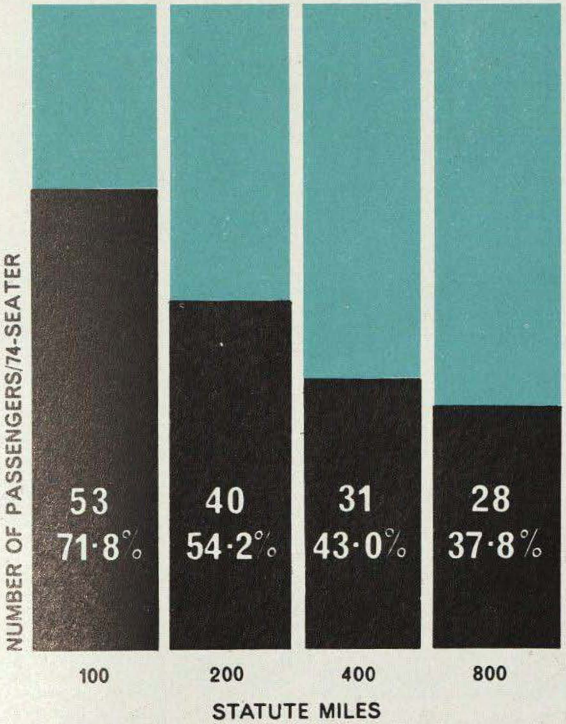
The seeds of short haul experience sown by the Vickers Viking and developed and matured world wide by the Vickers Viscount bear economic fruit in the One-Eleven. Low load levels in a structure which is extensively treated to prevent corrosion should lead to an airframe life of 20 years or more and a structure which should require no maintenance other than inspection during the first ten years of its life. The Rolls-Royce Spey engine enables the optimum engine/airframe match to be achieved and results in a higher percentage of take-off weight being devoted to fuel and payload to give a lower aircraft capital cost for the desired payload range characteristics, as well as lower fuel consumption.

Designed specifically to give economic operation on short hauls the Rolls-Royce Spey enables the One-Eleven to take departures from optimum cruise altitudes in its stride at minimum extra cost.

The One-Eleven has split systems which besides improving safety and reliability greatly reduce pilot work load and allow a very flexible approach to maintenance planning and form a necessary basis for an automatic landing system. An auxiliary power unit, airsteps, waist-high freight bays and servicing points enable the One-Eleven to be rapidly turned round with the minimum of trouble and also make it "self-contained" at a "whistle stop". Turn-round times and costs are cut and delay and damage stemming from ground equipment greatly reduced.

No airliner is economic if it does not attract the passenger. The One-Eleven's highly pressurized fuselage allows rapid aircraft rates of climb and descent without discomfort to the passenger. Rear-mounted engines give uniformly low noise levels through the cabin, coupled with an advanced form of air-conditioning ensuring a standard of passenger comfort never before experienced on the majority of short haul routes.

PASSENGERS REQUIRED TO BREAK EVEN



Operating Costs

As policy, BAC does not quote aircraft prices paid by its individual customers, which naturally vary according to equipment standard and date of manufacture.

It is not realistic for a manufacturer to publish precise operating costs, as these depend not only on first price but also on other variable factors particular to individual airlines.

A break-even passenger load factor, for example, cannot be given unless the sector distances and frequencies are stated even when all other factors are known.

This point is made because people frequently ask for break-even load factors to be stated without these qualifying factors.

Break-Even

Taking an "average" first cost and applying the 1960 ATA cost formula and assuming indirect costs to be the equal of direct costs, the BAC One-Eleven needs 53 passengers to break even at 100 statute miles, 40 at 200 miles, 31 at 400 miles and 28 at 800 miles.

FLIGHT DECK

Features of interest to airline pilots are shown in the accompanying picture of the flight deck.

Vision is enhanced by some of the largest windows and narrowest pillars of any airliner, flying or projected. The One-Eleven is the first and, to date, the only airliner whose vision envelopment is better than F.A.A. recommendations.

Simplicity of layout is combined with conventional positioning of vital instruments and systems for two-pilot operation. All controls are within easy reach of both pilots. Weather radar presentation and nose-wheel steering control are provided for each pilot.

Vital systems are on the centre panel, subsidiary systems being in the roof panel. Blind flying panels are built around the Collins Flight System in an uncluttered "T" layout. Above each panel are master warning lights. As is normal, engine instruments are centrally placed with space on either side for hydraulic, fuel and pressurisation systems. A neat pedestal embodies throttles, h.p. cocks, speed brakes, flaps and conventional trimmers with auto-pilot and radio controls operable by either pilot.

The split-system philosophy employed has considerably reduced the number and complexity of emergency drills to be carried out by making automatic use of the full performance of the remaining systems.

In addition, the number of controls and indicators on the flight deck has been significantly reduced compared with contemporary aircraft. There is no requirement for three crew members in any version of the One-Eleven. Flight deck design has not been compromised in any way to accommodate a third crew member.

The flight deck has the approval of the Air Registration Board and of the U.S.A. Federal Aviation Agency.

Stowage is provided for hats, coats, flight bags and airways charts. At no stage in flight should either pilot be required to leave his seat to deal with an emergency. A high standard of night lighting has been achieved.

Pilot influence has been exerted by a project pilot team on the design of the One-Eleven since it was conceived. Colour styling has been extended from the passenger cabin to the flight deck, which as a result is attractive as well as workmanlike.

A lockable folding door separates the flight deck from the passenger cabin.

THE PASSENGER CABIN

It is realised that precise furnishing schemes, layouts, position of galleys and a number of associated matters vary from airline to airline. The general points made in this section, however, are valid for any model of the One-Eleven.

The passenger accommodation has been designed for genuine flexibility in operation. Consequently, should a customer wish to alter the cabin arrangements to suit a particular form of operation, or to impose an individual airline "personality" on the interior, the job can be done relatively simply.

Toilets, galley units and other amenities are located at either end of the parallel-sided passenger cabin, in which seats and passenger service units and a divider bulkhead can be adjusted fore and aft in one-inch increments.

Charles Butler Associates of New York, internationally recognized experts in the field of aircraft interior design, have been retained by BAC to advise on cabin styling, decor and furnishing.

Airsteps & Doors

There are two passenger doors on the standard aircraft; one is forward of the passenger cabin and on the left side; the other is in the rear pressure bulkhead and is approached through a ventral entry with built-in hydraulically operated airsteps.

Airsteps can be fitted to the forward passenger entrance. They retract hydraulically, without folding, into a sealed sheath beneath the cabin floor and do not obstruct the use of jetways and other airport installations.

The galley service door is on the right hand side of the fuselage and opposite the forward passenger entrance.

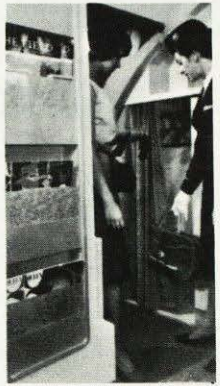
All doors are a plug fit (i.e. pressurization loads are carried by the door frame pressing on to the fuselage structure and not by a series of bolts). The forward doors open outwards on a parallel linkage and are fitted with an automatic lock to prevent them blowing in the wind. The rear door opens into a recess so that it does not obstruct the passage way from the ventral stairway to the cabin when open.

The door sizes are:

Rear Door	*6ft by 2ft 4in*
Forward Passenger Door	*5ft 8in by 2ft 9in*
Sill height	*7ft*
Galley Service Door	*4ft by 2ft 3in*
Sill height	*7ft*

All passenger doors can be opened from both inside and out and all can be comfortably opened with one hand. The two forward doors are opened by pushing down on the handle to lift the door and then outwards to swing it forward and clear of the doorway. The rear door operates in the same way as a household door.

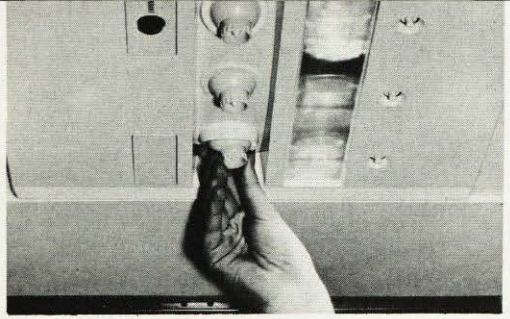
Ventral door

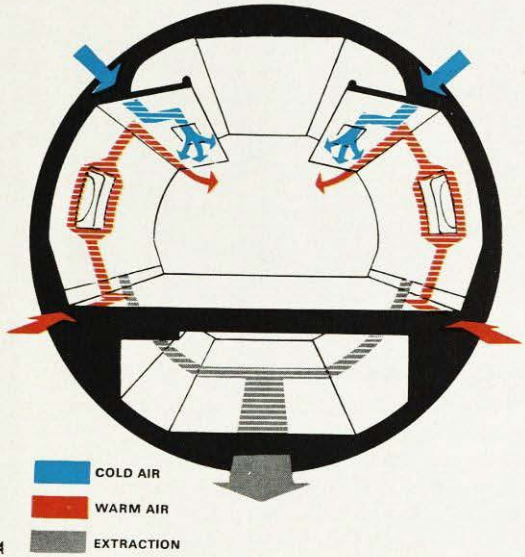


Forward door

Luggage Rack

There is a wardrobe and space for carry-on luggage just inside and to the left of each passenger entrance. Each is faced with a curtain. If required, additional carry-on luggage space could be created at the expense of a toilet or galley unit.





Cabin Environment

The fuselage can be pressurised to 7.5 lb per square inch without compromising the aeroplane's fatigue life. Sea level altitude can be held to 18,000 ft and at the One-Eleven's optimum cruising height of 25,000 ft the cabin altitude is 3,400 ft. Cabin rates of climb and descent are correspondingly low so passengers should suffer less ear-popping than has hitherto been the case in short-haul airliners.

The two halves of the split air-conditioning system can be controlled separately to give a different temperature on the flight deck from that in the passenger cabin. Both halves are controlled from the flight deck. Should one half fail, the other can supply conditioned air for both flight deck and cabin.

Conditioned air passes up behind the cabin side wall to warm it before entering the cabin through a grill beneath the hat rack. It leaves the cabin at floor level and passes around the sealed "class D" freight bays before being dumped overboard.

Temperature throughout the passenger cabin does not vary by more than 2½°F.

Fresh air is supplied by an individual louvre for each passenger.

Humidity is controlled by water separators in the air conditioning system.

Noise levels throughout the cabin are uniformly low as the engines are mounted behind the seating accommodation.

Furnishing & Insulation

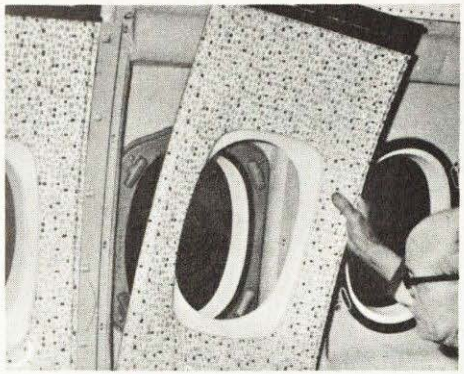
The covering and trimming of the cabin interior make use of Acrylic painted surfaces, plastic and upholstered fabrics, and plastic formings. Below the level of the hat rack, the interior trim is made up from semi-rigid pre-formed plastic mouldings, similar in design to those used in "big jet" aircraft. These "hard trim" panels are replaceable, easy to remove for inspection and maintenance purposes, and simple to keep clean.

The floor is covered with a removable fitted carpet and an underlay which forms part of the sound proofing.

The cabin side walls below the hat rack are insulated and sound-proofed by one-piece Fibreglass mouldings which seal the outside skin of the aircraft from the decorative trim panels and prevent condensation and the ingress of cold air. Conditioned air flows up between the cabin wall and this layer of insulation to give a warm cabin wall and is then puffed into the cabin through a grill below the hat rack. Fibre-

glass, contained in sealed bags, forms the insulating material that lines the roof and upper cabin walls.

The bulkheads are lightweight honeycomb structures with decorative plastic facings.



Passenger Seats

Passenger seats are normally chosen by the customer as each airline has its own preferences.

For weight and dimensional purposes, however, the standard aircraft has been considered fitted with Rumbold Type M1178/9 Double units (57lb per unit) in the first-class cabin and Rumbold Type M1016/7 and M1015 Double and Triple units (41lb and 59·5lb per unit) in the tourist class cabin.

The seat units are mounted on rails running the length of the cabin and have unlimited fore and aft movement in one-inch increments. Movable half-bulkheads, mounted on the seat rails, and an aisle curtain separate the first and tourist class cabins. "Fasten your lap straps" and "No smoking" signs are mounted above the curtains.

Windows & Window Blinds

There are 24 elliptical windows of "big jet" size (14 in by 9 in) along each side of the passenger cabin—one to every 20 in of cabin length or approximately two windows per row of seats. Blinds, which operate freely and remain at the selected position, are fitted to each window surround.

Emergency Exits & Equipment

The passenger compartment has four emergency exits—the forward passenger door on the left, the galley service door on the right, and one escape hatch on either side of the cabin above the wing. The ventral entry could be used as a fifth exit.

The main doors open outwards, the two emergency hatches inwards. All can be opened from inside or outside. Direct vision panels on the flight deck provide emergency exits for the flight crew.

Escape ropes are stowed in stainless steel tubes at all exits and there is provision for a non-inflatable chute in the roof between the forward passenger and galley service doors; this can be swung from a trapeze through either of these doors.

Emergency oxygen equipment can be fitted as a customer requirement.

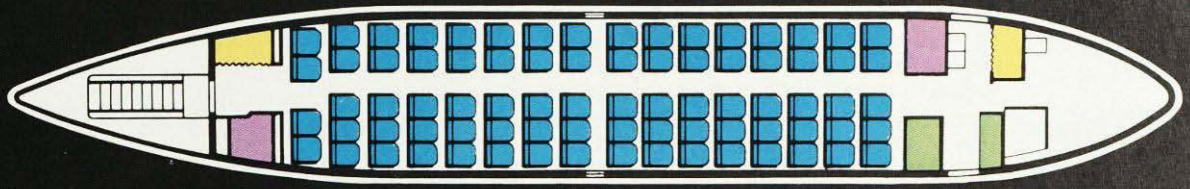
Immediately inside, and to the left of, the forward passenger door is a small locker containing a portable fire extinguisher. Further portable extinguishers, life jackets and therapeutic oxygen equipment are stowed between the rear toilet and the adjacent pressure bulkhead. Life jackets and emergency equipment for the cabin crew are housed beneath the folding crew seats in the forward vestibule.

An emergency lighting system is provided. It is battery-operated and thus independent of the aircraft's electrical system. It provides adequate illumination of the passenger cabin, essential notices and emergency exits.

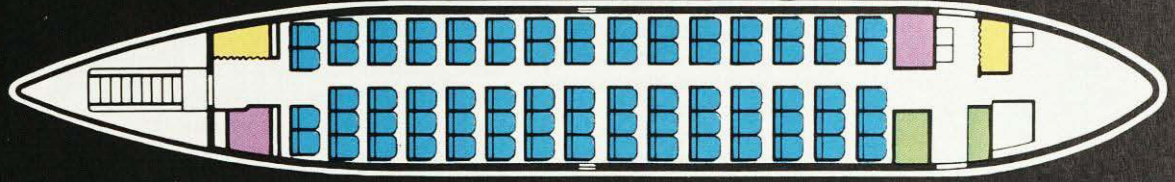
Passenger Service Units

A neat passenger service unit is mounted flush with the underside of the hat rack above each row of seats. Each unit contains air louvres, individual pre-focused reading lamps—one for each seat—and a call button. Ten per cent of the units have therapeutic oxygen points.

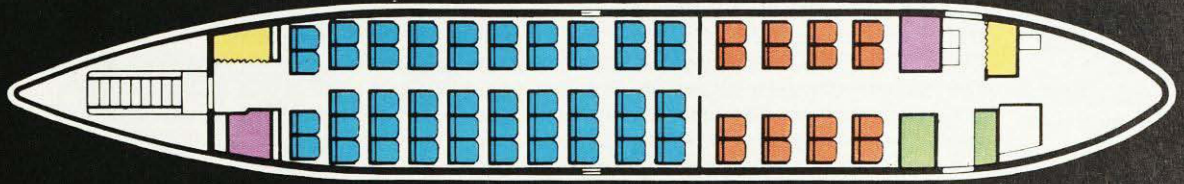
The units are movable fore and aft in one-



ECONOMY CLASS 79 PASSENGERS



ECONOMY CLASS 74 PASSENGERS



MIXED CLASS 16 FIRST CLASS 49 TOURIST CLASS PASSENGERS

FIRST CLASS SEATS

TOURIST CLASS SEATS

GALLEY

TOILET

PASSENGER COATS

inch stages, and further units can be rapidly installed or removed if the number of seat rows is changed.

The space between the units is filled with lightweight panels of honeycomb sandwich construction. The passenger service units overlap on these panels sufficiently to cater for all normal changes in seat pitches.

Cabin Crew Station

The forward vestibule is the cabin crew's station. Illuminated passenger call panels and the inter-communications and public address equipment controls are on the forward bulkhead, above the carry-on luggage space. On the bulkhead opposite this is mounted a folding double seat, fitted with lap straps and head rests. Emergency equipment for the cabin crew is stowed beneath it. A mirror above the flight deck door enables the stewardess to survey the aisle from this seat. A single (but otherwise similar) seat can be mounted at the rear of the passenger cabin on the forward bulkhead of the rear toilet, together with an adjacent control panel.

Fresh Water for Toilets & Galleys

Fresh water is pumped to the galley and toilets from a 20 Imperial gallon stainless steel tank, mounted on the right hand side of the fuselage under the cabin floor and to the side of the nose wheel bay. All the components were designed for ease of cleaning and to withstand freezing and sterilising without damage.

Fibreglass clamps and brackets insulate the system from cold structure and waste water is pumped overboard through electrically heated drains.

Toilets

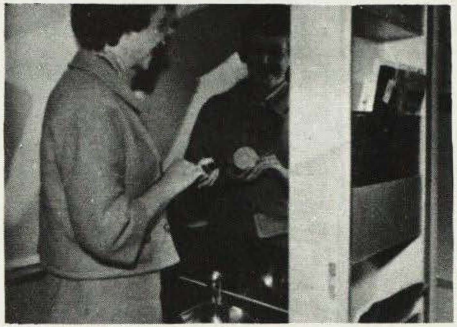
The standard One-Eleven has a toilet at either end of the passenger cabin. They are externally serviced through one-inch external connections in the fuselage side.

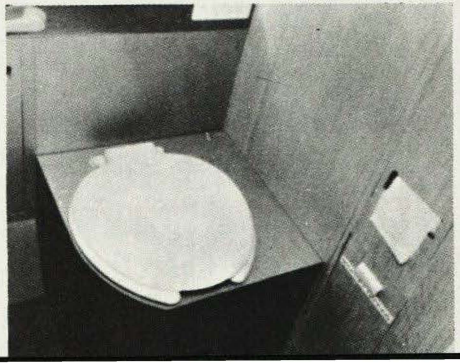
Both toilets are equipped with a flushing closet, washbasin (complete with warm water tap and in-line heater), soap dispenser, paper towel dispenser and waste bin, sanitary towel dispenser and waste bin, toilet-paper holder, mirror, ash tray, deodouriser and two coat hooks.

The closet is flushed by raising and lowering the lid. This operates an air pump and the air in turn moves the liquid. The pump itself never comes into contact with the liquids and consequently is not corroded by them.

The lightweight mirror which covers the entire bulkhead above the washbasin is made from a specially treated Melinex film. It is very light, shatterproof and does not mist up. A socket for a passenger's electric razor can be fitted near the lefthand bottom corner of the mirror.

The toilet doors are fitted with slide bar locks with an "occupied" indicator.





Galleys, Coffee Bars & Drinking Fountains

The galley is on the righthand side of the aeroplane between the flight deck and passenger cabin and opposite the forward vestibule. It is in two units, separated by a work space sufficient for two stewardesses. At the outboard end of the working space there is an outward-opening, plug-fitting service door which measures 4ft by 2ft 3in and has a sill height of about 7ft.

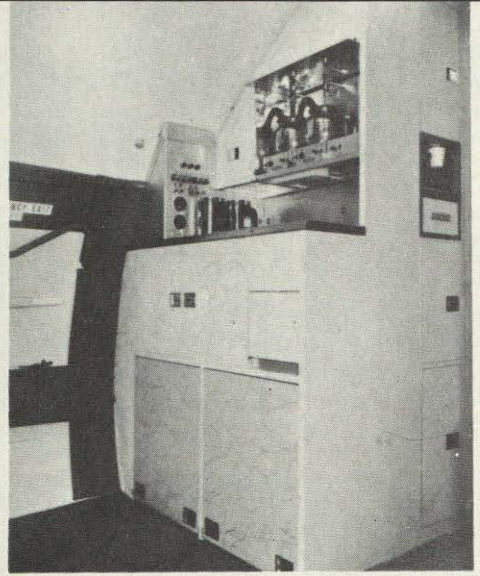
A typical galley would have a work-top, stowage for five standard meal containers (14 meals per container), cutlery, cups, liquids and a waste bin.

A drinking water fountain, with paper cups and cup disposal stowages, is provided in the galley area.

Galley units are not supplied with the aeroplane. To enable the customer to fit his own galley, electrical power (15 amp 3 phase constant frequency 200 volts) and water supply points are fitted in the galley area.

Some customers with short block-times have replaced the galley with a coffee bar and extra carry-on luggage space.

There is structural provision for a coffee bar or galley unit weighing up to 1,000lb. or a further toilet to be installed in the coat space opposite the rear toilet.



A typical galley unit

Skycots

No provision is made on the standard aircraft for mounting or stowing a skycot but one could be fitted to the hat-rack hand-rail which has more than adequate strength for the purpose.

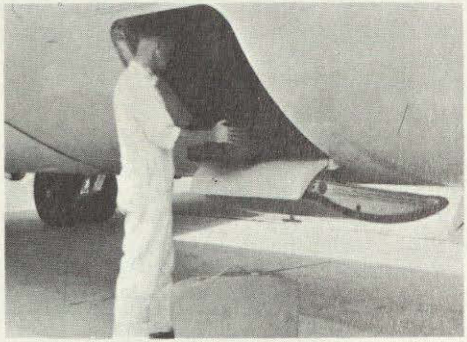
Trolleys

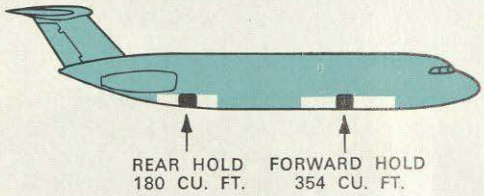
There is ample room for a trolley to be used without offending aisle passengers.

Baggage Holds

Two underfloor baggage holds with a total usable volume of 534 cu. ft. are provided within the pressurised fuselage.

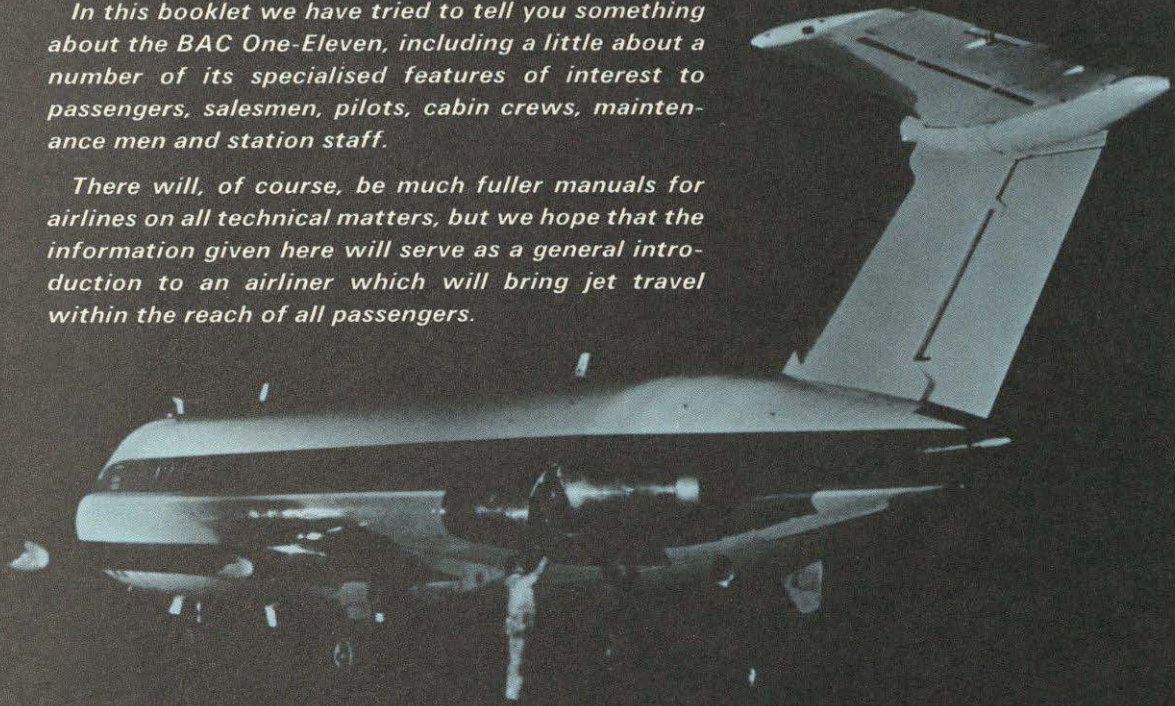
A plug-type loading door in each hold stows under the fuselage, completely clear of the waist-high loading sill.





In this booklet we have tried to tell you something about the BAC One-Eleven, including a little about a number of its specialised features of interest to passengers, salesmen, pilots, cabin crews, maintenance men and station staff.

There will, of course, be much fuller manuals for airlines on all technical matters, but we hope that the information given here will serve as a general introduction to an airliner which will bring jet travel within the reach of all passengers.



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